

THE APPLICABILITY OF A USE VALUE-BASED FILE RETENTION METHOD

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Abstract

The determination of the relative value of files is important for an organization while determining a retrieval service level for its files and a corresponding file retention policy. This paper discusses via a literature review methods for developing file retention policies based on the use values of files. On basis of these results we propose an enhanced version of one of them. In a case study, we demonstrate how one can develop a customized file retention policy by testing causal relations between file parameters and the use value of files. This case shows that, contrary to suggestions of previous research, the file type has no significant relation with the value of a file and thus should be excluded from a retention policy in this case. The case study also shows a strong relation between the position of a file user and the value of this file. Furthermore, we have improved the Information Value Questionnaire (IVQ) for subjective valuation of files. However, the resulting method needs software to be efficient in its application. Therefore, we developed a prototype for the automatic execution of a file retention policy. We conclude with a discussion.

1 Introduction

The goal of file retention policies is to store data on the appropriate medium that provides the required service level in the different stages of the data lifecycle (Tanaka et al., 2005). Here, by file we mean a digital document, and we use the term file and document interchangeably at some places, while retaining the above meaning. The lifecycle of files consists of four stages. The first stage is the creation of new file data or the modification of existing file data. In the second stage, the file is made accessible for other users, by for instance digital, written or verbal communication. The third stage is the actual access and usage of the file. After a period of usage, the file is either archived or deleted. The final stage is called retention. Throughout its lifecycle, the value of a file in general grows after the first stage and declines in the final stage (Tallon and Scannell, 2007). In the final stage, the intensity of usage mostly decreases and the accessibility of the files becomes less important. But, not all types of files have the same value and the file value may evolve differently depending on the file type. Consequently, one of the most important functions of a successful file retention policy is the ability to differentiate files by its value in an unbiased manner. We can then understand how the value evolves with time, so that decisions can be made on the appropriate storage medium or possible deletion of these documents (Chen, 2005). Hence, what is required is a method to relatively easily measure the use value of files by which a file retention policy can be determined. Such methods are proposed in the literature but we question their applicability. Therefore, our research question is “*How effective is a method for file retention in practice?*” To understand the practical operation of such a method, we first derive an appropriate method from an analysis of literature. Next, we discuss the applicability of the method in the context of CapGemini Netherlands and then describe a tool that we

have developed which can help in executing the method *efficiently*. The paper concludes with a reflection on the findings and suggestions for further research.

2 Literature review

We started our research with a structured literature review to arrive at a better understanding of the previous work on data retention policy formation methods. Nine data retention policy formation methods have been found in the literature. These methods include the determination of file retention decision parameters (like goals and file attributes) on basis of file valuations. Table 1 gives an overview of these methods.

Method	Goal of data retention policy	Important file attributes
(Chen, 2005)	Capture the changing file value throughout the lifecycle and present value differences of files	Frequency of use; Recency of use
(Turczyk et al., 2008)	Determine the probability of future use of files for deciding on the most cost-effective storage medium	Time since last access; Age of file; Number of access; File type
(Bhagwan et al., 2005)	Lay out storage system mechanisms that can ensure high performance and availability	Frequency of use
(Verma et al., 2005)	Optimize storage allocation based on policies	Frequency of use; File type
(Mesnier et al., 2004)	Classify automatically the properties of files to predict their value	Frequency of use; File type; Access mode
(Zadok, 2004)	Select files that can be compressed to reduce the rate of storage consumption	Directory; File name; User; Application
(Strange, 1992)	Optimize storage in a hierarchal storage management (HSM) solution	Least recently used
(Gibson and Miller, 1999)	Reduce storage consumption on primary storage location	Time since last Access
(Shah et al., 2006)	Design a cost efficient data placement plan while allowing efficient access to all important data	Metadata; User input; Policies

Table 1: File Policy Retention Determination Methods

A number of criteria for a file retention policy method are present in the literature:

1. The retention policy determination method has to function with little to no human intervention (Chen, 2005, Turczyk et al., 2008), The execution of file valuation as a manual rating of individual is mostly too costly. A simple directory can easily contain 6,000 files; evaluating them piece for piece will take many hours if not days.
2. The method should be based on the subjective use value of files over time in their different life stages (Chen, 2005, Turczyk et al., 2008). It is obvious that value is a subjective and often individual characteristic.
3. The method has to use multiple file attributes for the valuation process (Turczyk et al., 2008). One file attribute will not be able to cover all value determining variables.

All the file retention policy determination methods of table 1 can be automated, and thus fulfill the first criterion. In the valuation method of Mesnier [5], the files are only valued at the moment of creation and the value is not measured over time. This method can therefore be excluded as it does not satisfy criterion 2. The method of Verma is excluded for the same reason (criterion 2). The valuation methods of Strange [7], Bhagwan [3] et al. and Gibson & Miller [8] are excluded because they use only one measure for the valuation of the data, and hence do not satisfy the third criterion.

After the evaluation of the literature, only four methods fit the criteria of our research objective; (1) Usage-over-Time Method (Chen, 2005); (2) Probability of Further Use (Turczyk et al., 2008); (3) Elastic File Quota System (Zadok, 2004); and (4) the ACE Framework (Shah et al., 2006).

Chen’s (2005) *usage-over-time* approach to indirectly determine the value of a file, however has as drawback that it does not incorporate the knowledge of administrators and users of the files (Chen, 2005, Matthesius and Stelzer, 2008). Furthermore, the method does not take into account that the value of files is not necessarily reflected in their usage. For instance, a trade agreement or contract is of critical value for a business, but the usage count for these types of files can be very low. Developing and adding a classification scheme based on the contents of files could increase the effectiveness of this method.

Turczyk et al’s method to determine the *probability of future use* (Turczyk et al., 2008, Turczyk et al., 2007) has as drawback that all calculations are based on the characteristics and usage of files, while the content and context of a file is not considered in the calculations.

The Elastic Quota File System (EQFS) method developed by Zadok et al. aims to reduce the need for more space on a file system by an intelligent set of policies that allows one user to use the free disk space of another user (Zadok, 2004). The EQFS method uses the experience of data administrators and users to identify the elastic files. When defining the policies for elastic file determination, gaming and politics are unavoidable resulting in subjective allocations of higher service levels (speed of access and disk space) to some actors (Zadok, 2004).

We find the ACE framework developed by Shah et al (2006) to be an exemplar method for developing a file retention policy. The framework presents tools and methods for the classification of files and storage locations as well as tools for file placement. The data classification method of ACE is based on *metadata* (data attributes) and these attributes are compared with *predefined policies*. In the article of Shah et al. (2006), it is stated that these policies are included in the framework and are based on the consultation of experts (Shah et al., 2006). However, they do not discuss how these policies can be defined. This is remarkable, because a file valuation method can infer priorities of placements. Table 2 provides an overview of our assessment of the four methods discussed above.

Criterion/Method	Usage over time	Future use probability	Elastic quota file system	ACE: Data classification
Little human intervention	X	X	X	X
Frequency of use	X	X		X
Measurable metrics	X	X	X	X
Classification of data	X	X	X	X
Knowledge of data managers and users			X	X
Cost reductions	X	X	X	X
System performance				X
Business value of data				X

Table 2: Assessment of Methods

3 Research objectives

The ACE framework is the only method which fulfills all the assessment criteria described in Table 2. However, the determination of retention policies by this framework is problematic. The first problem is that policies should be specified by information *users* not by system administrators (Tanaka et al., 2005). An information user is typically a business person, who often has difficulties with understanding metadata attributes. This makes it difficult for a business person to specify policies (Tanaka et al., 2005). The second problem is that developing file retention policies is a time consuming task (Ohta et al., 2006) and realizing a complete set of policies that cover all files, is too labor intensive (Jin et al., 2008). Administrators generally use the rules-of-thumb for policy selection, often in anticipation of a certain workload (Short, 2006).

ACE describes a classification of files by its relevant attributes in order to make retention decisions. However, ACE does not provide guidelines on how the selection of these parameters (i.e. the

development of the retention policy) represents the user's valuation of files. Therefore, this paper uses causal relations between file attributes and the (subjective) use value of the files to determine file retention policies.

For subjective valuation of files, Sajko et. al. (2006) developed an information value questionnaire (IVQ) that allows information workers to value the information they use. The IVQ has five dimensions (1) Files Lost, (2) costs of file (Re)building; (3) Market Value; (4) Legislative, and (5) Time as an indicator of obsolescence. The "Lost" dimension measures the impact of information loss on the business operations. This can be anything from "*nothing special*" to "*making wrong decisions with major consequences*". "(Re)building" measures the cost of replacing the lost information (from "*negligibly small*" to "*intolerably high costs*"). "Market value" measures the consequences if competitors obtain the information (from "*nothing*" to "*competitor gets competitive advantage*"). "Legislative" identifies the obligation to keep the information and the legal consequences if the information is lost (from "*no obligation*" to "*keeping information is obligatory and sanctions are strict*"). The "Time" dimension measures the rate at which the information depreciates in value (from "*very quickly*" to "*does not depreciate at all*").

This questionnaire cannot be automated, and is therefore not directly suitable for an efficient method for determining data retention policy. The measures that are used are subjective; the rankings of different persons are therefore required to create inter-subjective reliability. Because people answer the questionnaire according to their perceptions, the value that is determined is the 'perceived business value'. However, IVQ can be used to align file attributes with use value and utilize this insight to efficiently rank files. By measuring subjective values of information entities, we can combine these values with attributes (like last access date and modification date) of files, and then prioritize these attributes to arrive at a decision policy. The approach we hence take is to combine objective observable file attributes with the more subjective IVQ measure. Thus, the most important attributes can be identified and used to be applied to prioritize files over different storage media. We thus can summarize a method for determining a data retention policy, as consisting of the following steps:

1. Select a feasible size of representative files and identify their attributes.
2. Let (a sample of) users score the business value of these documents.
3. Correlate value score with the file attributes.
4. Take those file attributes with high correlations with business value as decision parameters in the retention policy. Leave out weakly correlated attributes.
5. Propose the results to users and discuss the applicability of the results.

In the next section, we describe the different propositions containing causal relations between file attributes and subjective file values, and consequently describe our conceptual model.

4 Conceptual Model and Propositions

It is expected that the behavior of a file has causal relations with its value. Here, by behavior we mean file usage, i.e. the frequency with which the document is accessed or modified. Based on these causal relations, it is possible to select appropriate file retention parameters. Therefore, for data retention we have the following propositions;

Proposition 1: The frequency of access of a file predicts its value.

This proposition is based on the idea that a file is more valuable if it is used more heavily than other files (Chen, 2005). If this correlation is corroborated in this case, file attribute "frequency of access" should be included in the use value-based retention policy as a decision parameter. Unfortunately, the frequency of use is not logged in a Windows file system, and therefore a proxy of "frequency of access" is needed consisting of users' 'perceived frequency of access'. Consequently we have the following proposition,

Proposition 1a: A higher (perceived) frequency of access results in a higher file value.

Gibson and Miller developed a ‘file-aging’ algorithm based on the assumption that older files are used less and therefore less valuable (Gibson and Miller, 1999). This leads to the following sub-propositions:

Proposition 1b: The older the file the lower the value of the file.

The last modification time of a document refers to the number of days since the file was last updated. If a file is updated recently it implies that people are actively working with the file and therefore the value of the file is higher. Consequently, we have the following proposition:

Proposition 1c: A more recent time of last file modification results in a higher file value.

Turczyk examined the characteristics of different files to find the probability distributions that can be used to determine the probability of future use. He found that the probability distribution depends on the file type of a document (Turczyk et al., 2008). This results in proposition 1d:

Proposition 1d: The file type can be used to predict the file value.

The position that a person has in the organization may also influence the file use value (FUV). The reason for this is that the type of files that are used by people in an organization depends on their line of work. Organizational functions (named “grades” in our case study of CapGemini) are used to define the function level of the personnel, resulting in:

Proposition 2: A higher grade of the user results in a higher value for the file they use.

The propositions made above are summarized in the causal model shown in Figure 1. This model displays the observed variables of the files (file age, last modification time, and file type), the behavioral construct of the respondent (user grade) and the perceptual constructs of the respondents (perceived frequency of access and file value). The different constructs are numbered C.1 to C.6.

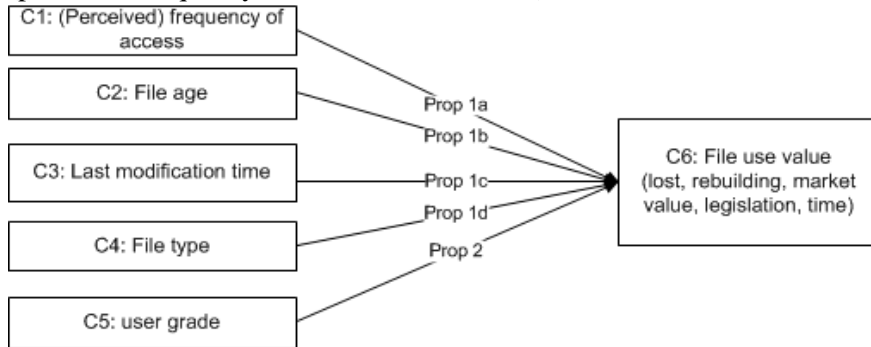


Figure 1: Causalities between file retention parameters (c1-5) and file use value (c6)

Consequently, if the correlations of these propositions are corroborated, frequency of access, file age, last modification time, file type and user grade could be included as decision parameters.

In the next section we test the propositions in the case on CapGemini, Netherlands. We then go on to describe the results of the case study.

5 Case Study

5.1 Data collection

In CapGemini Netherlands, we collected a dataset to test the propositions. In the dataset the following elements were collected (i) the metadata attributes of a document; (ii) completed IVQ for this document; (iii) the grade of the respondent, and (iv) the perceived frequency of use. The respondents of our questionnaire were asked to indicate his or her current grade at CapGemini. CapGemini uses these grades to indicate the function level of their personnel: consultant, senior consultant, managing

consultant, principle consultant, and business support (secretaries and others). To increase the effectiveness of the questionnaires we applied the following two rules: (1) Each respondent was asked to complete the IVQ for at least 5 files, and (2) Only files of the following file types could be selected; .doc, .xls, and .pdf. These file types were selected on our perception of their importance for CapGemini's business.

An overview of the constructs is presented in table 3.

Code	Name	Based on	Scale
C.1	Perceived Frequency of Use	Question added to the IVQ regarding perceived frequency of access per time period	Answers are normalized to 'number of accesses per year'
C.2	File Age	'File creation date' in metadata	Number of days since creation date
C.3	Last Modification Time	'File last modification date' in metadata	Number of days since last modification
C.4	File Type	'File type' in metadata	Extension of file (.doc/.xls/.pdf)
C.5	User Grade	Question in IVQ	Grade at CapGemini
C.6	File Value	Scores in IVQ	Total score of the five questions in the IVQ, ranging from 0 to 20
<i>Table 3: Constructs</i>			

For the case study an electronic application was developed. We used this application to collect the valuations of files and the metadata of these files. The application followed the following workflow:

1. The respondent manually selected five files that s/he wanted to value.
2. After selecting five different files, the respondent could progress to the next page. On this page the IVQ was displayed for the first file.
3. The IVQ had five multiple choice questions with five possible answers with scores in a range from 0 to 4. We added a sixth question, asking the respondent to give an indication of the number of times s/he uses the files.
4. When the IVQ was completed, the respondent was asked to select the employee's current grade at CapGemini.

Everyone in the financial service sector of CapGemini Netherlands received an invitation to participate in the case study. In total 654 people were invited, and 77 completed the IVQ, a response rate of 12%. All respondents were asked to complete the IVQ questions for at least 5 different files. In total the 77 respondents assessed the value of 387 files. A factor analysis was performed to determine if the questions in the IVQ all load on the files' use value (FUV) construct.

Item	File Use Value
Lost	.830
ReBuilding	.800
MarketValue	.742
Legislation	.763
Time	
<i>Table 4: Factor loadings of File Use Value</i>	

The calculated value (0.79) shows that factor analysis is appropriate for the dataset (Field, 2005). The factor analysis indicates that the time-items for the file value construct measurement at CapGemini are not relevant, and thus the time question does not load on the FUV factor.

5.2 Data analysis

Linear regressions analysis was used to test the propositions.. For this we performed a Spearman rho's correlation on the variables as advised by Blalock (Blalock Jr, 1979) for ordinal data, after having recoded the nominal variable file type (C4) to dummy variables. Table 5 gives the statistical results, and demonstrates that propositions 1a (*A higher perceived frequency of access results in a higher file value*), 1b (*The older the file the lower the value of the file*), 1c (*A more recent last modification time results in a higher file value*) and 2 (*A higher grade of the user results in a higher value for the files they use*) are corroborated and proposition 1d (*The file type can be used to predict the value of a file*) is rejected, also when counting for interrelations among the independent variables.

		C1	C2	C3	C4.xls	C4.doc	C4.pdf	C5	C6
Spearman's rho	C1	Correlation Coefficient	1.000	-	-.278**	-.094	-.094	-.048	.417**
		Sig. (2-tailed)	.	.508**	.000	.065	.065	.344	.000
		N	387	387	387	387	387	387	387
	C2	Correlation Coefficient	-.508**	1.000	-.207**	.043	.119*	-.041	-.228**
		Sig. (2-tailed)	.000	.	.000	.398	.019	.419	.000
		N	387	387	387	387	387	387	387
	C3	Correlation Coefficient	-.547**	.901**	1.000	-.266**	.075	.153**	-.235**
		Sig. (2-tailed)	.000	.000	.	.000	.143	.003	.731
		N	387	387	387	387	387	387	387
	C4.xls	Correlation Coefficient	.278**	-.207**	1.000	-.478**	-.229**	-.067	.094
		Sig. (2-tailed)	.000	.000	.	.000	.000	.190	.066
		N	387	387	387	387	387	387	387
	C4.doc	Correlation Coefficient	-.094	.043	-.478**	1.000	-.310**	-.078	-.063
		Sig. (2-tailed)	.065	.398	.000	.	.000	.124	.216
		N	387	387	387	387	387	387	387
	C4.pdf	Correlation Coefficient	-.094	.119*	-.229**	-.310**	1.000	-.115*	-.091
		Sig. (2-tailed)	.065	.019	.003	.000	.	.024	.074
		N	387	387	387	387	387	387	387
	C5	Correlation Coefficient	-.048	-.041	-.067	-.078	-.115*	1.000	.145**
		Sig. (2-tailed)	.344	.419	.731	.124	.024	.	.004
		N	387	387	387	387	387	387	387
	C6	Correlation Coefficient	.417**	-.228**	.094	-.063	-.091	.145**	1.000
				.235**					

Sig. (2-tailed)	.000	.000	.000	.066	.216	.074	.004	.
N	387	387	387	387	387	387	387	387

Table 5: Spearman's rho for testing the propositions

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

6 Case discussion

In the case study, we found that the file type of a file has no significant causal relation with the value of a file. File type, contrary to suggestions of others (Verma et al, 2005; Mesnier et al, 2004; Turczyck et al, 2007), is therefore not a usable attribute to specify policies at CapGemini, at the moment we conducted the case study. We also found that a reliable measure of FUV, namely, the IVQ instrument as proposed by Sajko et al. (2006), could be based on 4 instead of 5 factors (depending on the case study). As we have shown in our case study that we can exclude the Time factor.

To be useful, the method should contribute in resolving a relevant business problem. To be practical, the method should be workable in an organizational environment. We operationalized usefulness and practicality with the following checklist questions:

1. How can this method help you in your project(s)?
2. What do you consider to be strong points of this method?
3. What do you consider to be the weaker points of this method?
4. Can you think of a useful contribution to our method?

We received the following responses from the experts:

- The frequency of issues can depend on the season in a year. If some files become more valuable in a certain season, the accessibility of those files can be increased (during the season). This helps the people that are looking for the files.
- We find that the method designed in this research is not suitable to predict the future behavior and value of files. Consequently, the testing of these propositions must be repeated regularly as part of a policy determination method.
- The value assigned to a file depends on the role and the position of a person in the organization. It can therefore be useful to develop 'profiles' of persons. The profile can, for instance, be used to sort the search results of a person. Then, we can place the files with the highest value for the person on top of the search results. The profile can also be used for personalized information on intranet web pages, such as knowledge portals. Files that are assigned a high value by users with the same profile can be presented on the front page of the knowledge portal. The method can determine the moment when a file makes the transition from being directly accessible to being archived or deleted. The designed method can thus be used to select valuable files to publish on a knowledge portal.
- The method can substantially reduce the gap between the work of archivists and the business environment. It can furthermore reduce the workload that is associated with the development of storage policies.

Finally, depending on the outcome of the IVQ a company can create a file retention policy suitable for the particular company. Table 6 summarizes the findings for CapGemini.

Qualitative indicators (IVQ)	
Costs of loss	Difficult to assess for each file separately
Cost of rebuilding	Difficult to assess for each file separately
Market value	Difficult to assess for each file separately

Legislative requirements	Easy to assess for each file separately
Time	Difficult to assess for each file separately; probably a redundant item in IVQ
Added: Perceived frequency of use	Difficult to assess for each file separately
File attributes	
Frequency of access	Can be easily assessed; but unclear evidence of correlation with value
File age	Can be easily assessed; evidence of correlation with value
Last modification time	Can be easily assessed; evidence of correlation with value
File type	Can be easily assessed; but no evidence of correlation with value
User grade	Can be easily assessed; evidence of correlation with value
<i>Table 6: Applicability of file retention policy elements in the context of CagGemini</i>	

Depending on whether the criteria are important, they can be used to create the file retention policy. For example, the file retention policy can state that all files associated with a particular project and accessed at least 5 times in the last week need to be stored in a particular database. A file retention policy can depend on a combination of qualitative indicators and file attributes, but in the case where many files have to be reviewed, a qualitative approach will have to be replaced by a file attribute based approach. Therefore, the key problem with the method, mentioned frequently by the experts, has to do with the execution of the method. Consequently, we have developed a prototype of a tool that could efficiently and automatically, identify files for potential removal. This CtC tool (CtC stands for “cut the crap”), takes 5 user chosen directories as input, and then the tool delivers reports of the files in the chosen directories based on creation, last modified and last access time, as well as frequency of use. We have also implemented a predictive use value measure. Some screens for it are given below. Figures 2f, 2g, 2h plot the number of files versus the last access, creation and last modification time respectively. While figure 2e lists all the documents (in the 5 directories) along with their business use value. This business use value is calculated based on the different attributes of the file (creation, last modification, last access time as well as frequency of access). Figures 2b and 2c show a subset of the files displayed in figure 2e, depending on the business use value. While figure 2a plots the number of files with the business use value of the files. Finally, just like with our method the tool takes user feedback on the appropriateness of the business use value of 4 randomly chosen files. The tool user can then potentially use this feedback to modify the business use value calculation. The tool is tested on students at the moment, but when well assessed will be experimented at CapGemini.

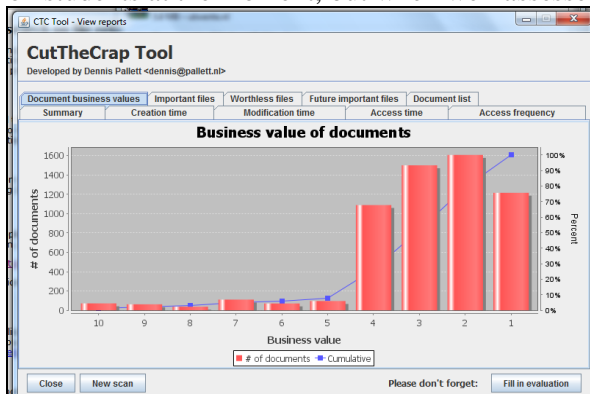


Fig 2a: Business value of documents

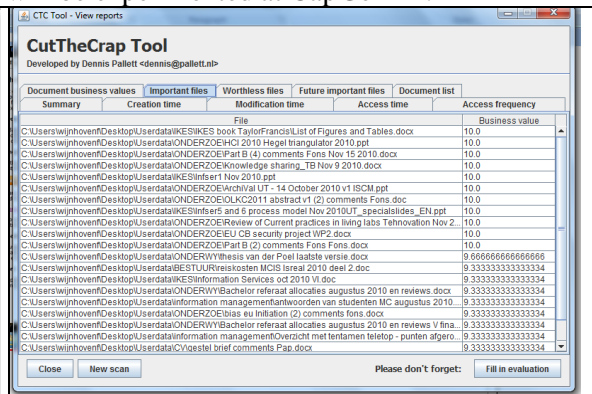


Fig 2b: List of important files

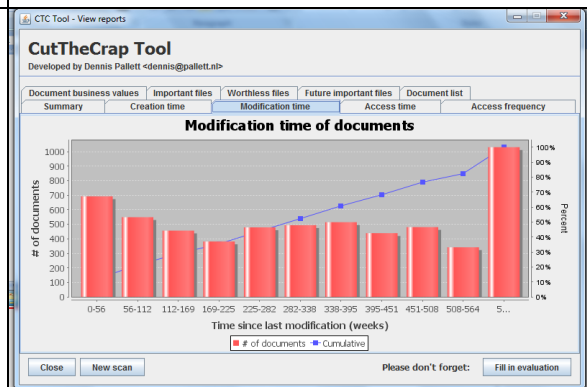
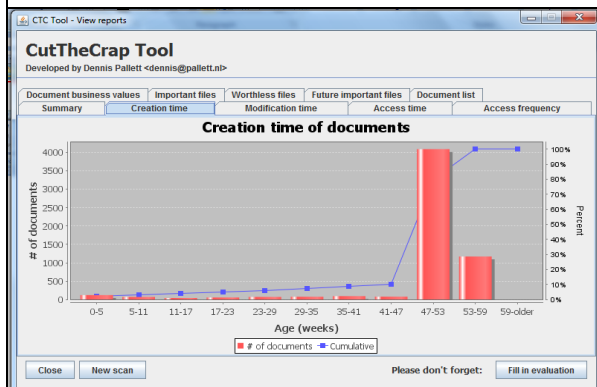
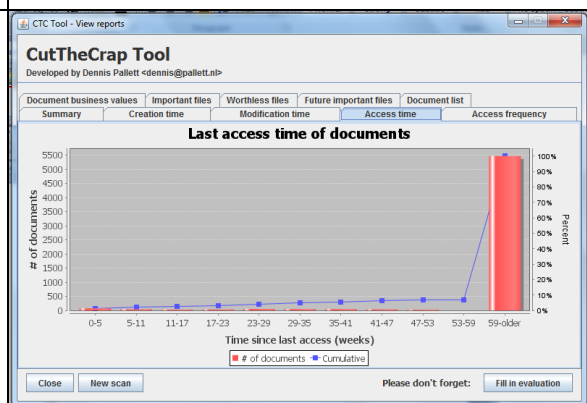
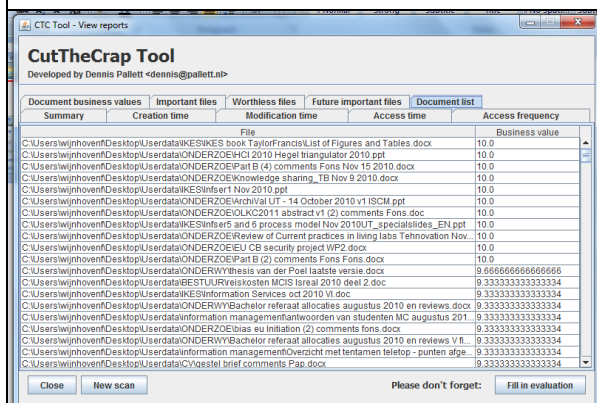
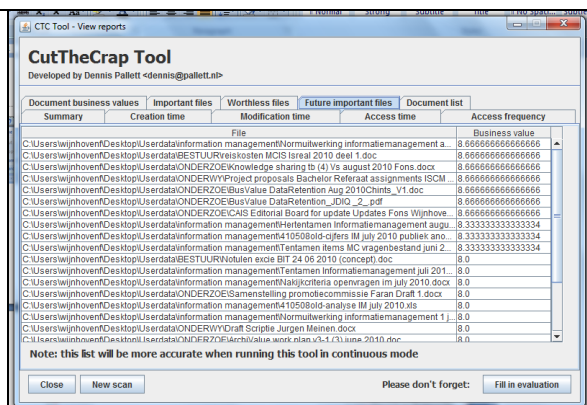
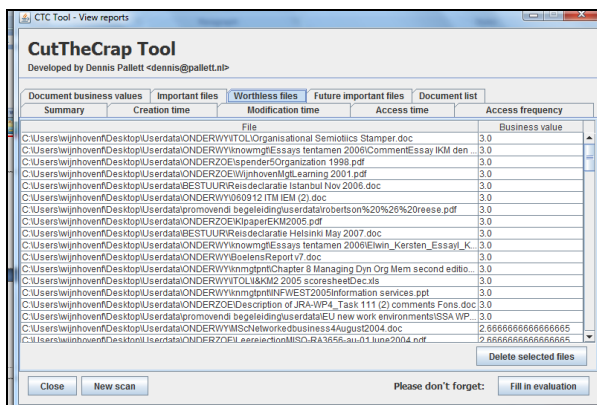


Fig 2q: Creation time statistics

Fig 2h: Modification time statistics

Figure 2: Screenshots of the CtC tool.

7 Conclusions

The goal of this research was to answer the following research question: *“How effective is a method for file retention in practice?”*. In this research we have described and later demonstrated a method by which a company’s file retention policies (based on the use value of the files) can be determined. We have shown that the use value of files can successfully determine useful policy parameters. We have

shown that the file behavioral parameters and the context parameter (grade) together can predict the subjective value (FUV) of files. Consequently, these parameters should be part of a file retention policy determination method.

We have shown (through the case study), that there is a strong causal relation between the position of the user of a file and the value of the file. We have therefore improved the ACE method by including the position of the user of a file. We have also noted that ACE is a method which is context dependent. In other words it would provide different results depending on the setting in which it is used. As such, the *method is generalizable*, but its *results are hence probably not generalizable*. This implies that a file retention policy should not only include goals and relevant attributes, but also a *procedure* which guarantees a regular test of attributes in relation to their impact on use value.

The questionnaire helps practitioners in the information life cycle management field to move towards a business oriented approach. We found that people became more aware of the value of their files during the process of the case study. We observed that the employees started discussions about the amount of invaluable data on their own laptops and the data that reside in the different knowledge bases in the organization. With the questionnaire, the business people were stimulated to develop a critical approach towards the files they used and stored. This awareness can be one of the first steps to reducing some of the causes of data proliferation. Furthermore, we think that this study also shows that actual implementation of file retention actions (like file removal or storage to an indirect storage medium) is not just a technical task, or the prime task of a database administrator. Rather, *file retention actions are also a task for the owners of the files, which in most cases are their end users*. In making file retention decisions, however, end users can be well supported by database administrators, who can take the responsibility for the file retention policies and procedures. The administrators can also advice the end users on basis of research results.

Although the use value based method for file retention policies is consistent with the theory, its practical use is doubtful, given the labor intensity of its application. Consequently, we have developed a prototype of a software tool that can help in an efficient execution of the method. This software tool is however still not yet as fully tested and developed that it can be used already in practice. We are still testing it in a larger group of students, and may in later research test it in an organizational setting. The need for a tool like the CtC tool however, has become clear and we invite readers to pick up the idea for further research.

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